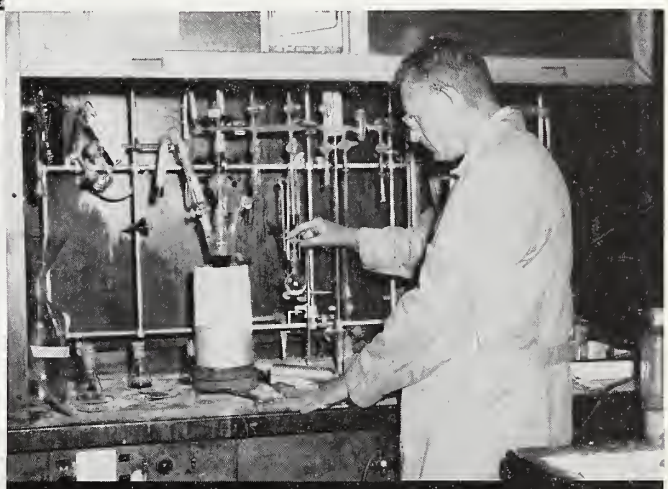
AGRICULTURAL Research

February/1959

U. S. DEPARTMENT OF AGRICULTURE



AGRICULTURAL
Research

Vol. 7—February 1959—No. 8

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Planning

Most of our important scientific discoveries of the past were not—and could not—be *planned* in detail.

Take, for example, Fleming's observation of the germ-killing power of penicillin or, more recently, Knipling's insight into the possibility of using sterile male insects to eradicate whole populations of such pests as the screwworm.

Planning is no substitute for good scientists. Yet, as more money, materials, and men have gone into research, good planning has become increasingly important—to cut delay and waste, and to get the most out of our resources.

Yes, planning and research are inseparable. But difficulties arise unless we clearly understand the extent to which research *can* be planned. and unless we make sure that the right people do the planning. Let's distinguish between the planning *of* research and planning *for* research.

Planning *of* research should be done by scientists. Research involves systematic observation and collection of facts, and meticulous testing of hypotheses by experiment. Both these operations, to give meaningful results, must be carefully planned. This planning can generally be done only one experiment at a time because research results cannot be predicted.

Planning *for* research is an administrative job, done in consultation with the scientists. This means deciding what research is to be done and seeing that personnel, funds, work space, and equipment and supplies are available—each a big job in itself. Now, the only use some scientists see for administrative people is to interpret the red tape which—in the scientists' view—the administrative people themselves have created. But what man is more frustrated than a scientist whose supplies aren't there when he needs them?

ARS Administrator B. T. Shaw recently observed that administrators should recognize the special characteristics of research work and the special qualities of scientific minds. And he urged scientists to accept the organization and regulations that are essential for all large-scale operations.

In administration—as in research—we need alertness to new possibilities, an open-minded and imaginative approach.

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3 WAY CHEMICAL ADVANCE AGAINST INSECTS

STRUCTURAL model of compound serves chemists as tool in their study of residue determination.

Researchers are showing gains in a quest for compounds to make better insecticides, attractants, and repellents

■ USDA SCIENTISTS ARE ADVANCING against insect pests along three chemical fronts. Chemists and entomologists are developing more effective yet safer insecticides . . . attractants . . . repellents.

A promising new insecticide—less harmful to warm-blooded animals than any in use—is now in the final stages of development. Known as 6-chloropiperonyl chrysanthemumate, it is one of some 900 compounds synthesized in the past year at the ARS pesticide chemicals research laboratories at Beltsville, Md. The new insecticide is only one-eighth as toxic to animals as pyrethrum and one-third as toxic as allethrin. Pyrethrum, a natural product, and allethrin, a pyrethrum-like material developed by ARS chemists in 1949, have been the safest insecticides.

An effective attractant for the Mediterranean fruit fly is another new compound synthesized at the Beltsville laboratory. Following tests in Hawaii, the attractant replaced scarce angelica seed oil in the thousands of traps hung throughout Florida in the campaign to eradicate the fruit fly there. Traps baited with the attractant to lure Medflies enabled scouting crews to map infested areas, plan spraying operations, and check on progress of the eradication campaign. Attractants are specific for each insect, and the scientists are continuing their efforts to discover or synthesize compounds for use against the gypsy moth, pink bollworm, and boll weevil, as well as other fruit-fly pests.

TURN PAGE

3-Way CHEMICAL Advance Against Insects

(Continued)

Diethyltoluamide is the chemical name of a superior all-purpose insect repellent, newest of a series of successful repellents developed by the ARS scientists. It was primarily developed to protect military personnel from malaria and other insect-borne diseases. The repellent is now commercially available (under different trade names) for the protection of picnickers, backyard gardeners, and all people who work or play outdoors.

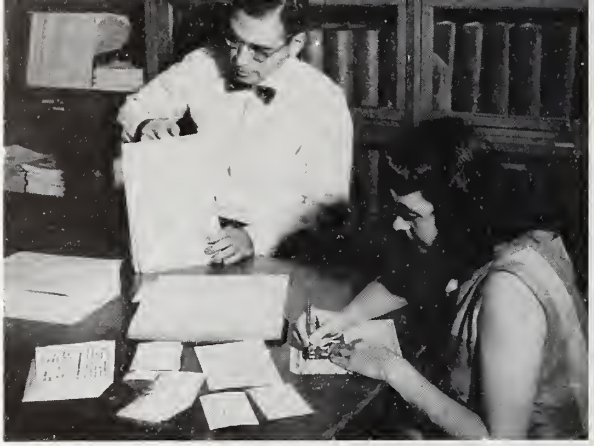
Before a new compound is released for use against harmful insects, it undergoes extensive field tests by cooperating entomologists throughout the United States. The results are analyzed and evaluated.

The next step is to find out the proper dosage and method of application of a promising new chemical. Particle size and other physical properties are studied to develop the most effective forms and mixtures; physical and chemical characteristics relating to its use in aerosols are determined; problems of deterioration in storage of both chemical and container are solved.

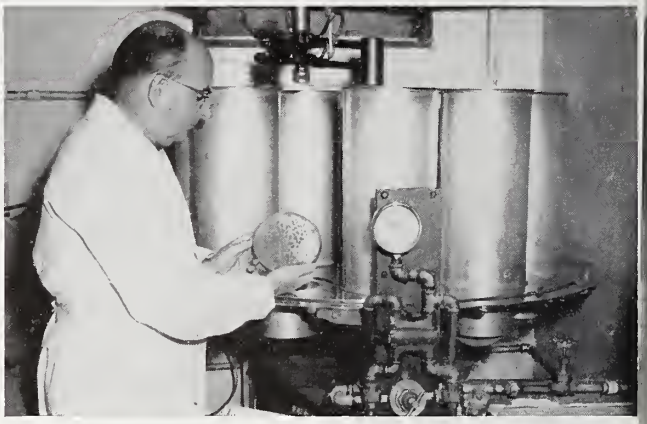
If an insecticide is intended for use on fruit, vegetable, or forage crops, the residues on treated crops are painstakingly analyzed. The strength and rate of application recommended for use on a particular crop must conform with safe tolerances set by law.

All this research is aimed at making our insecticidal chemicals deadly to the pest but safe to use.

These photographs take you behind the scenes in the research laboratories where pesticide chemicals are synthesized and analyzed, and their effects studied. ☆



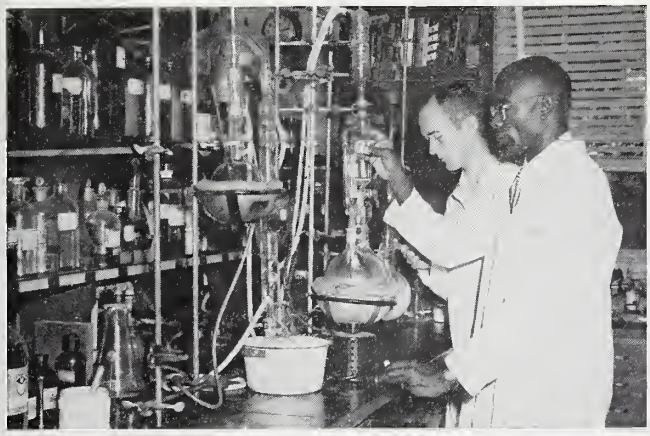
1. Test data on 9,000 chemicals are filed at laboratory. Punch-card system enables chemist M. Beroza to quickly sort out compounds with pesticidal properties related to his problem. Mrs. Flossie Thompson records new data.



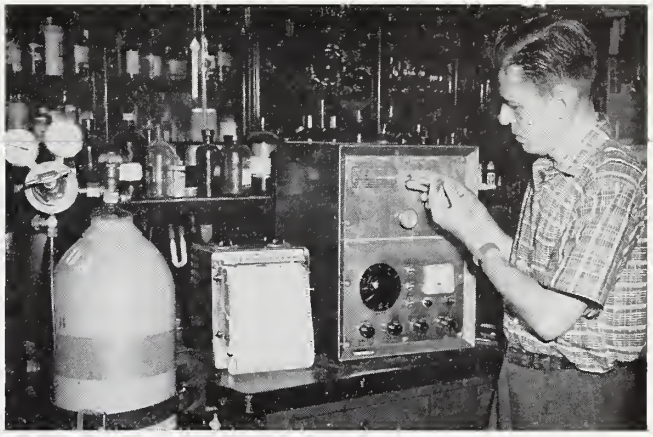
4. New insecticides are tested in apparatus designed by ARS scientists. Entomologist P. G. Piquett places screened petri dishes, each containing 100 flies, inside cylinders. He then sprays into each a measured dose of insecticide.

7. X-ray diffraction negative of insecticide powder gives physicist E. L. Gooden picture of structure of its particles. Information about physical properties of pesticides is needed to formulate effective mixtures of chemicals.

8. Basic information on amount of insecticide left on fruits, vegetables, and forage after treatment is obtained by chemist W. E. Westlake. First step in determining residue is to put containers of treated food, solvent on tumbler.

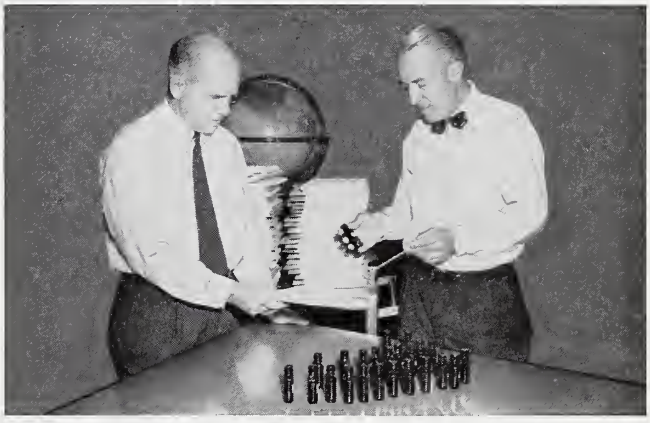


Synthesizing new organic compound is team assignment for chemists B. H. Alexander, R. T. Brown. Process involves series of intricate and precise procedures. Hundreds of new compounds are synthesized here each year for testing.



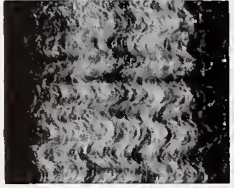
Gas chromatography is used by chemist M. Jacobson in tracking down volatile part of natural insect attractant. Synthesis of factor will be attempted. Roots, other materials are checked for substances useful against insects.

5. Roach repellent is effective if insects avoid treated half of paper lining of dish. Entomologist Otelia Bodenstein counts roaches in each section at intervals in test. At rear are other test dishes using inverted paper containers.



6. Promising new pesticide is discussed by S. A. Hall (right), director of ARS pesticide chemicals research, and E. E. Fleck, assistant director. Reports of testing by entomologists at field laboratories are seen in background.

9. Residues of organic phosphorus insecticides are analyzed by chemist Helen G. Wheeler, using enzymatic method. This is one of various sensitive methods adapted or developed by the pesticide researchers for residue determinations.



We need a way to measure wool fiber waves so we can find their relation to other selection factors and answer the question:

HOW IMPORTANT IS WOOL CRIMP?

A NEW METHOD of measuring curliness (crimp) of a sheep's wool from projected images of wool fibers may be useful in sheep selection.

Crimp occurs in the form of waves or curls greatly resembling the fashionable tightly marcelled curls of a few decades ago. These curls are still very much in style, however, in the wool staple. Recent indications are that crimp is an important factor in wool processing and in quality of products. Wool men think more crimps per inch and more uniform crimp mean better wool.

Objective measure needed

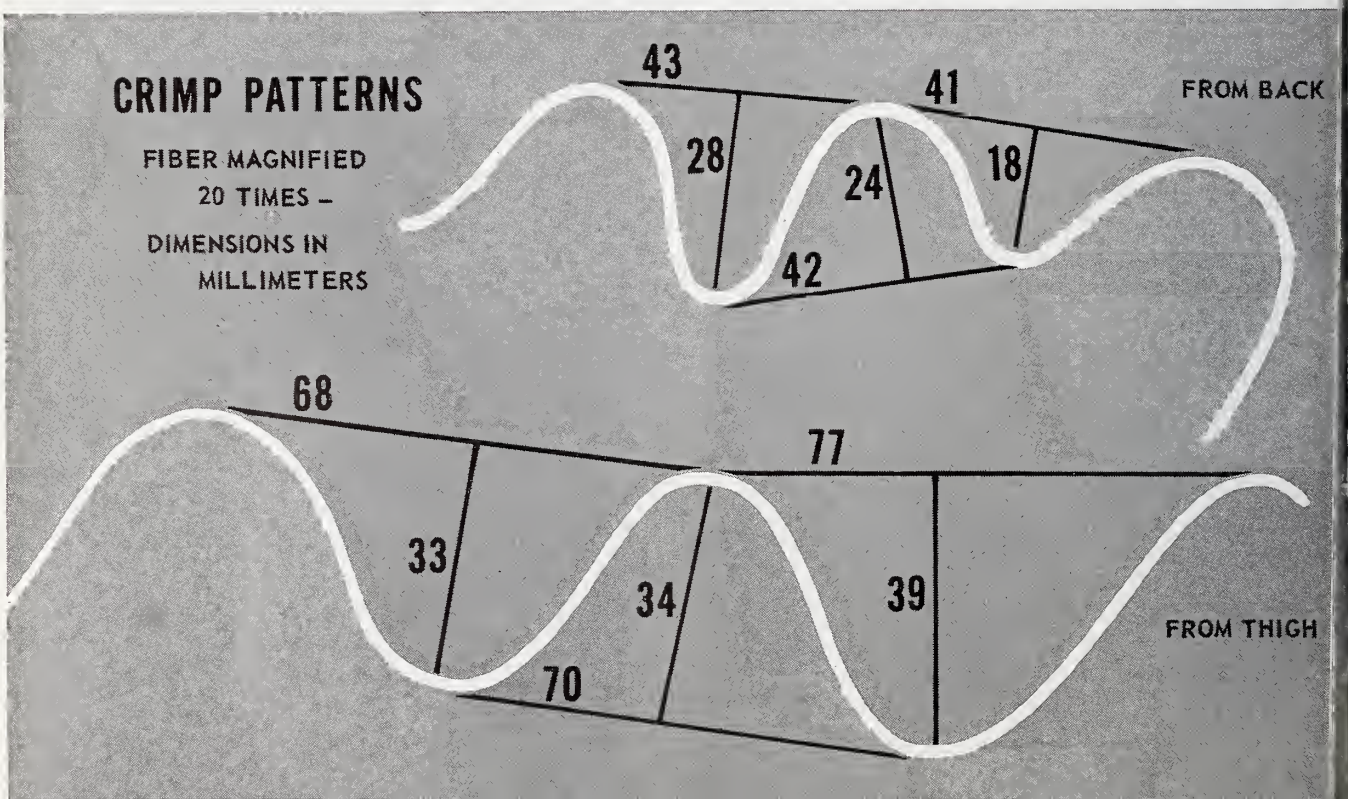
Yet there's no information on the *actual* value of crimp in relation to the many other factors that go into selection. To determine crimp's possible value, researchers first had to find out how it could be measured quickly, simply, inexpensively, and objectively. This is what scientists at USDA's Agricultural Research Center, Beltsville, Md., are doing.

ARS fiber technologist Mary Hourihan, animal husbandman C. E. Terrill, and associates chose grease wool locks at random from shoulders, backs, and thighs of Merino and Shropshire yearling ewes from the Beltsville flocks. A sample of wool was selected from each grease lock, placed between two glass slides, and put into an ordinary vertical projector. The crimp image, magnified 20 times, was projected onto a piece of paper. The operator arbitrarily selected a distinct crimp pattern, drew it on paper, and measured the width and depth of three crimps c curls at three locations.

Many variations evaluated

After crimp width and depth we measured from the drawings, widt to-depth ratio and number of crim per inch were calculated. ARS b ometrician W. R. Harvey evaluat the importance of variability b ewes, areas on ewes, locations c lock, and samples within locks. H also evaluated variations due to di ferences among operators in selectir samples, preparing slides, selecting crimp pattern, and drawing the pr jected image. Also checked were tl interactions among all of these factor

The wider and deeper crimp on tl coarser Shropshire wool resulted fewer crimps per inch, although tl



atio of width to depth was only ightly lower than that of the Merino ool. Important differences were ound in crimp measurements beveen sheep, between areas on the heep, and between locations on the ock. For example, there was little ifference in crimp pattern between houlder and back wool in Merinos. ut in Shropshires, the shoulder ool had a wider and deeper crimp ith a greater width-to-depth ratio.

In both breeds, the thigh wool had uch wider and deeper crimps with greater width-to-depth ratio than ool from the other two areas. hus, locks from all areas of the heep and various locations on the ock must be sampled to describe the rimp pattern of a fleece.

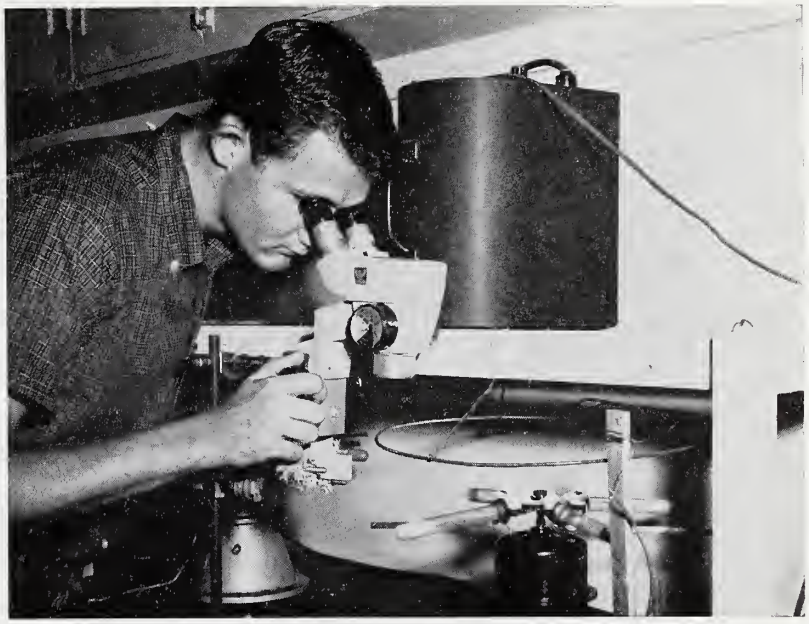
In both breeds, crimp became narower (more crimps per inch) and eeper in going from the tip to the ase of the fiber. This may reflect change in the nature of growth of he wool from birth to yearling age.)r it may simply mean a straightening as the wool becomes less dense rowing farther from the base.

tandardization is sought

The biggest obstacle now is to tandardize techniques in preparing lides and in drawing and measuring rimp patterns. Preliminary experiments indicate that satisfactory standrdization *can* be developed. Howver, before any design can give reiable estimates of average staple rimp pattern for a particular fleece, nore information is needed on the ariability among locks on various reas of the sheep, and variability mong operators. Additional work long these lines is planned. ☆

RELATIONSHIP of crimp measurements (width, depth, ratio of both) to value of crimp in breeding for higher quality wool is being studied. Crimp patterns are being related to many quality factors in sheep, wool, and processing, to determine crimp's statistical value in selection.

Tryout for SPACE TRAVEL



WHIRLING tubes seem to stand still when flashes from Stroboscope (upper right) synchronize with centrifuge rotation. Operator observes flies in tubes through microscope. Ring above centrifuge reminds operator not to touch stationary-appearing test tubes. (Photo shutter speed: 1/2000.)

■ FRUIT FLIES (*Drosophila melanogaster*) are helping USDA scientists find out the effect of space travel on normal life processes. Studies are developing basic information on insect reactions—information that will be needed when insects are used as biological indicators in space.

Tests conducted by ARS entomologists W. N. Sullivan and G. E. Westlake show that these insects can withstand the force of 10 times normal gravity. This makes them highly suitable for use in space biology studies when temperature and carbon dioxide balance can be maintained. In addition, these insects are easily reared in a test tube, have a short life cycle, and their genetics are widely known.

The researchers kept the flies through 2 generations—35 days—constantly subjected to a force approximately equivalent to a space vehicle's launching acceleration. Under this force a man weighs 10 times as much as at normal gravity and is apt to black out.

Newly hatched insects grew to adulthood in 9 to 18 days—almost as soon as those reared at normal gravity. Of 1,000 eggs in each group, 412 exposed to 10 G reached the adult stage while 953 of the controls completed the life cycle of the first generation. Larvae, probably of a third generation, were present when the experiment was concluded.

The 10–G force was obtained by a centrifuge whirling insects in test tubes at 240 revolutions per minute. The researchers watched the development of the insects without stopping the apparatus by using a Stroboscope—an instrument that flashes light on and off in synchronization with the revolutions of the centrifuge. The tubes seem to stand still, permitting close observations of the flies' activities. ☆

branding *onion* outcasts

Marker genes in inbred lines reveal mixtures, help keep our hybrid seed pure

■ HYBRID ONION LINES are being bred to show off their heredity. Using basic genetic techniques, scientists at USDA's Agricultural Research Center, Beltsville, Md., pair plants to give identifying colors and shapes that flag the slightest taint of mixed parentage. These genetic giveaways—from marker genes—are being developed to assure farmers of high-quality hybrid seed.

In producing hybrid onion seed, a pollen-sterile inbred line is interplanted with a second inbred line that bears pollen. This assures that only cross-fertilization produces seed on the pollen-sterile rows—the ones to be harvested. But there is danger of pollen contamination in producing the parent lines. Particularly serious is accidental breeding of male *fertility* rather than male *sterility* into the future mother line. That leads to pollen-bearing plants in the seed row and some self-fertilization—that is, some inbred seed mixed with the hybrid seed. Marker genes show up such contamination.

ONION FLOWER HEAD and individual florets or floret parts carry easy-to-spot colors and shapes.

With markers, seed growers can easily spot undesirable mixtures of inbred lines before planting or in the seed field. Thus, roguing is faster and more thorough.

Many traits under study for use as markers

Marker genes can be recessive or dominant, but they must control traits that show up in predictable ways if

Here are a few combinations of the many mar

FLOWER STATE

Open flower

Closed flower

TEPAL SHAPE

Long, pointed tepal

Round, short tepal

ANTHER LENGTH

Long anther

Short anther

the hybrid cross gets an undesired parent. We understand how only a few visible traits in onions are inherited, but many other traits are being studied as possible markers. ARS horticulturist E. W. Davis, who has done much of this basic research, is particularly looking for traits to flag seed-producing inbreds.

Three pure breeding lines are needed to produce high-quality commercial F_1 hybrid onion seed. The male-sterile line to bear seeds and the male-fertile line to fertilize it have already been explained. These breeding lines have many genetic differences, a main factor in their offsprings' vigor. In addition, the male-sterile line must be maintained by a closely related male-fertile line (AGR. RES., July 1954, p. 10).

Davis has found that recessive genes bred into the seed-producing inbred lines are best to bring out offtypes. Because dominant traits supplant recessive traits in the first generation, an outcross is revealed before mixing can be carried to a later generation.

For one typical marker, Davis uses the single recessive gene that makes the perianth (petals and sepals) white in Early Yellow Globe inbred B 5546—seed parent of Elite. When the marked inbred is crossed with a plant having green perianth, the recessive white gives way to dominant green in the offspring.

Using several markers in both the male-sterile and male-fertile inbred lines makes it easier to spot offtypes. Each new trait doubles the possible markers—with 10 traits, the 2 alternatives for each would result in 1,024 marker combinations. The aim, however, is to use just enough characters for fast, easy identification. For example, several hereditary colors can be used in combination for bulbs (dominant white, recessive white, red, yellow, or complementary red), for anthers (light green, dark green, yellow, pale yellow, chocolate, or red), and for flowers (white, green, or bright green). Distinct tepal shapes—from long-pointed to short-round—serve as good markers in some varieties.

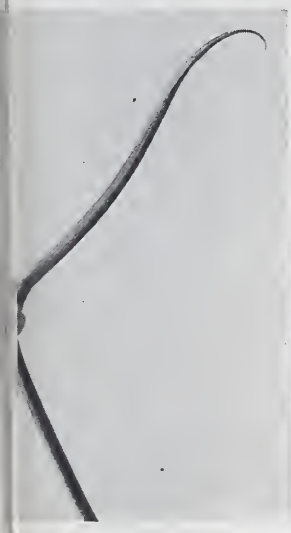
Some characters show before pollen is shed

Markers that identify offtype plants before pollen is shed offer added safeguards. These traits show up mixed bulbs or seeds of the inbred lines. If not caught in the bulb stage, the marked mixtures could be caught later in the flowering stage. Several combinations of these early-appearing traits look promising: red or yellow bulb; glossy or non-glossy foliage or seedstem; brown or black seed; firm or drooping umbel; and closed or open flower. Some flower traits—such as green or white perianth, yellow or green anther, and short or long anther—also show up before the pollen is shed.

Special characters in certain varieties offer other possibilities. The Brigham Yellow Globe has stiff flower stems and firm umbels (flower heads), but Yellow Sweet Spanish has weak flower stems and loose umbels. Another good marker is the long, pointed spathe (umbel sheath) of Sweet Spanish inbred B 12132. This apparently dominant character is in all first generations.

Davis and co-workers are building a "gene bank" of onion traits under study as markers. As traits prove suitable, they will be made available to breeders and seed producers. Agricultural Experiment Stations of New York, Michigan, Wisconsin, Idaho, Texas, California, Utah, Colorado, and Iowa are cooperating. ☆

r traits under study



SPATHE LENGTH

Long beak

Short beak

MECHANIZING SMALL TREE-FRUIT HARVEST

Catcher-conveyors combined with tree shaker do a quick, efficient job

CATCHER-CONVEYOR can be operated by one man walking behind the machine, where controls for moving, steering, positioning, and for running conveyor belt are in easy reach. Unit includes 2 catcher-conveyors, 1 tree-shaking machine.

■ HARVESTING SMALL TREE FRUIT at a rate of 30 to 50 trees an hour is possible with the aid of a self-propelled catcher-conveyor designed by USDA-State engineers.

Two of the catcher-conveyors and a tractor-mounted mechanical tree shaker comprise a harvesting unit.

The two catcher-conveyors, placed on either side of a tree and joined together around the trunk, catch fruit that's dislodged by the shaker. The shaker's 20-foot boom (AGR. RES., October 1958, p. 6) reaches over the catcher-conveyors and clamps around a tree trunk or limb. The mechanized unit harvests prunes, plums, and cherries with minimum bruising of the fruit.

Movable canvas-covered flaps of each catcher-conveyor slant toward the canvas conveyor belt. Fruit rolls from the flaps onto the slowly moving conveyor, or falls directly on it. The conveyor forms the bottom of the machine and carries the fruit to boxes at the rear.

Only 3 men are required to operate the 2 catcher-conveyors and a tree shaker. Seven or more men are needed to handle old-type fruit-catching frames and the tree-shaker. In either case, of course, additional labor is required to move and load filled boxes of fruit.

P. A. Adrian, ARS agricultural engineer at Davis, Calif., designed the catcher-conveyor with the aid of R. B. Fridley, California Agricultural Experiment Station engineer. A private concern furnished materials and constructed a full-size experimental model.

The test machine is low-built for maneuverability in orchards. A 3-horsepower gas engine provides for forward and reverse motion and operation of the belt.

Catcher-conveyors can be built for about $2,000 a pair and will be commercially available this year. ☆

TEST MACHINE is about 18 feet long and has full-length conveyor belt 6 feet wide. Tree side of machine is fitted with 2 end-to-end flaps 1½ feet wide. Flaps are canvas on tubular steel frame—track-mounted so they can be moved against the tree; hinged for independent operation; and shaped where they meet, to fit part way around the tree. Flaps of one unit would lap over flaps of a second unit on opposite side of tree. Flap on outer side is 4 feet wide, hinge-mounted, manually operated. All flaps fold in to rest on belt for tree-to-tree moving.

NEW SPRAYER-DUSTER

It applies chemicals wet or dry, and several unusual design features make its performance outstanding

DRAGGING BOOMS hold spray nozzles and duster outlets at right height and distance from plants to cover foliage thoroughly.

A VERSATILE SPRAYER-DUSTER, developed cooperatively in USDA and State research holds promise for use on several low-growing row crops.

Used successfully against aphids on potatoes during the past 3 years in Oregon and Washington, the sprayer-duster will be tried for applying insecticides to lettuce and broccoli. Other row crops to which the machine may be adapted include string and lima beans, egg plant, cabbage, cauliflower, collards, and strawberries.

Tests have demonstrated the flexibility of this machine for either spraying or dusting. It can be adjusted for use on low-growing crops of different row spacings. Treating booms may be moved horizontally and vertically within rows. This permits spray nozzles and dust outlets mounted on the booms to be operated at a uniform height above the ground for accurate placement of insecticides on upper and under parts of plants.

Why the combination of sprayer and duster in one machine? For low-volume spraying, a supplemental air blast was needed to further atomize the liquid as it leaves the nozzle. What better source of air blast than a duster? Hence, the decision to build spray nozzles onto a duster. The double-purpose unit lets farmers apply chemicals wet or dry, depending on what the situation calls for.

ARS agricultural engineer V. D. Young and entomologist J. C. Chamberlain led in this development at Forest Grove, Oreg. The work was conducted in cooperation with the Oregon, Washington, and Idaho Agricultural Experiment Stations, and Washington State Potato Commission.

Machine is thorough, safe

With currently used insecticides, the researchers got almost complete control of the aphids without significant mechanical damage to vines.

The unit can be powered by a row-crop tractor or other suitable vehicle. A horizontal tubular drawbar is attached to the vehicle at a right angle to the direction of travel. Sprayer-duster booms are attached to the drawbar by universal joint and rest their weight at the other end on ski-like shoes that trail along the ground midway between rows. Thus, atomizing spray nozzles and dust outlets on the booms are at a constant height and distance from the plants.

Air stream picks up spray

One set of nozzles mounted within the dust outlets is directed to treat under the leaves and near the ground level in adjacent rows. The high-velocity air stream discharging around the nozzles picks up the spray, breaks it up to some extent, and forces it through and around the plants. Another set of nozzles treats the tops and sides of the same plants. ☆

WAYS WITH WATER WEEDS

Chemical controls for the costly pests are cooperatively sought through research, basic and appl

■ THE ENORMOUS COST of weeds in canals, streams, and other waterways and the need to conserve water are stimulating research on methods of aquatic weed control. USDA and cooperating agencies are giving special attention to herbicides, so useful on other types of plants.

Each kind of aquatic weed presents a different problem. Some kinds grow completely submersed in water, others float on it, and some hold their tops above the water's surface. Bank weeds grow at the waterline, or immediately above, with their roots extending down into moist or saturated soil. Phreatophytes (shrubs that grow along waterways, such as willow, salt cedar, and cottonwood) send roots down to the ground water or to the capillary fringe above.

Weeds cost in many ways

All these plants lose a great deal of water in transpiration, reducing the supply for irrigated crops. Also, weeds obstruct the flow of water; clog weirs and other structures; provide breeding grounds for obnoxious insects; and impede navigation, fishing, boating, swimming, and hunting. Sometimes weeds cause objectionable odors and flavors in drinking water.

ARS is cooperating with the U. S. Department of Interior and with State experiment stations in basic research on plant physiology and in tests to find more effective herbicides and better methods of applying them in and along waterways.

An example is the study of how chemicals added to surrounding water are absorbed and move in submersed plants. These plants have few veins for movement of sap in leaf, stem, and root tissues. Little had been known about action of chemicals in them until plant physiologists F. S. Aldrich and N. E. Otto, at Denver, Colo., devised a method of isolating root and leaf-stem tissues.

The scientists threaded the stem and leaf part of Sago pondweed (*Potamogeton pectinatus*) through a tiny hole in a thin latex membrane. The hole contracted around the stem, forming a seal. When the plant was put in a beaker with the membrane fastened over the lip, the membrane formed a pouch that held a liquid about the stem-leaf portion, separate from the root. Thus, chemical could be added to the liquid around ei the root or the leaf-stem section.

Using this device, the researcl found that chemicals move downw in plants—regardless of whether chemical is absorbed through lea or through roots. The accumula of the chemical in all plants was m extensive in roots than in lea This information will guide resea ers in applying chemicals.

Herbicides are well tested

Before potential herbicides can recommended for use, they must tested to make sure that they weeds but do not harm fish, anim or man. Also, an herbicide must harm crop plants when it rea them through irrigation water.

Cooperative research has paid For example, the discovery and of aromatic solvents, or ethyla hydrocarbons, has resulted in be weed control in Western States at estimated saving of over a mil dollars in 1957. ARS agronor F. L. Timmons points out that us aromatic solvents also reduced c losses from inadequate irrigation water losses. Mixed with gaso

l heavy chlorinated benzenes, matic solvents are used successly in Florida water-control canals. Control of cattail with herbicides presents another saving. Spraying h a low volatile ester of 2,4–D and oil-water emulsion costs from $24 $43 per mile of canal as compared $407 to $418 per mile for draging, the traditional method. More ently, dalapon and amitrol, alough more expensive, have shown ne advantages over 2,4–D.

lt-cedar control studied

Cooperative work on phreatophytes s been limited mostly to a few exriments on control of willows in ah, Montana, and Washington, and a series of experiments on salt dar in Arizona and Wyoming. ese tests showed that the most effece and least expensive method for ntrol of salt cedar is to first clear f the mature growth by mechanical eans or by burning. The regrowth sprayed with low-volatile esters of 4,5–T and 2,4–D. The treatment ould be repeated once or twice each ar to kill all sprouts and new edlings. Recent results indicate at silvex is more effective on salt dar than 2,4,5–T or 2,4–D.

Further work is needed to find a etter way to control large-area inestations. The goal is an effective, nexpensive chemical treatment that on't harm cotton or other crops. ☆

EAVY growth of pondweed, algae, nd anacharis in channel of this Utah rigation canal (left) impeded water ow. Six days after trichlorobenzene vas added to water, submersed weeds lisappeared. As water moved more reely (right), less was lost by vaporation and by banks overflowing ecause of the clogged channel. Chemical treatment was much cheaper han mechanical methods involving and labor such as chaining or dragging would have been. The chemical was tested to make sure it would kill weeds without harming crop plants.

FARMERS AND SOCIAL SECURITY

■ SOCIAL SECURITY, familiar and vital part of urban living since the early 1940's, today is a new but just as vital rural institution.

Farm operators first came under Old Age and Survivors Insurance in 1955. Since that time, OASI has won rural support and acceptance. This is evident from studies by USDA agricultural economists.

Retirement plans of a large and increasing number of farm families hinge on their participation in the Government social security plan. What's more, about a half million farm families this year are receiving benefit checks. In many cases the checks supplement savings, private insurance pensions, and certain farm-based income. But for some small operators, OASI benefits are the major resource for retirement.

How many farmers now pay the social security tax on their self-employment income? About 2.3 million participated in 1955. The total was 200,000 larger in 1956, according to data compiled by ARS agricultural economist John C. Ellickson. This increase came while the number of farm operators was dropping more than 100,000. About two-fifths of all farmers who paid the self-employment tax in both years netted less than $1200. Participation in 1957 evidently continued high.

This wide acceptance is interesting in view of the fact that coverage is voluntary with many low-income farmers, and they must take the initiative in paying the tax to the Internal Revenue Service. Nonfarm self-employed don't have this option. Wage and salary workers also must participate, but their tax is automatically paid by payroll deductions.

Ellickson suggests that farmer acceptance of OASI coverage may be due indirectly to three complexities of modern rural life:

First of all, many farmers gained social security coverage before farm income first came under the law in 1955, by working in industry and other off-farm jobs to supplement their income. Thus, they learned early how OASI operates. OASI benefits were even more apparent to rural people after full-time hired farm workers were covered in 1950.

A second factor may be the difficulties that older farmers and those with few resources and low income have in making a living from farming. These small operators cannot keep up with operators of large modern farms with heavy capital investment. Older farmers also may have found that subsistence farming could not provide enough of their wants in a complex economy. Ellickson cites the relatively large proportion of old-age assistance applications that had come from rural counties in the years before farmers could qualify under OASI. Cream and egg money, or other traditional sources of retirement income for small farm operators, evidently was not enough to support many older couples.

Finally, following the lead of others may also have had a role in some farmers' acceptance, once the OASI program got under way.☆

■ An organic phosphorus compound called APO may hold the answer to improving popular wash-and-wear cotton garments, according to USDA scientists.

Investigations at the ARS Southern utilization division, New Orleans, show that APO solves one of the major problems associated with some of the other wash-and-wear finishes—the tendency, particularly in white shirts and blouses, to yellow or otherwise discolor when treate with chlorine bleaches. APO finish is highly resista to damage from these bleaches, which are commonly use in both home and commercial laundering.

APO also gives cotton outstanding crease retention ar wrinkle resistance. Changes in the feel, or "hand," the fabric are slight, and the treatment is far more durab than any known wash-and-wear finish. In addition, AP treatment increases flame resistance of the fabric to son extent, depending on the amount added and on the co struction and weight of the fabric. However, sma amounts will change the burning characteristics of th fabric and afford some protection to the wearer.

Currently, cost of APO (most of the chemical we us is imported) is the major obstacle to commercial adoptio of this new treatment. Experimental production of AP on a small scale by two U. S. firms indicates it can b made at lower cost in this country. Other companie have expressed interest in producing APO.

Scientists at the New Orleans laboratory did their firs work with APO—chemically, (tris (1-aziridinyl) phos phine oxide—while seeking ways to make cotton flam resistant. During their experiments, chemists G. I Drake, Jr., and J. D. Guthrie noted that treated cotto samples had excellent wrinkle resistance. Further check ing showed that APO-treated cottons had better creas retention and wrinkle resistance than most of the presen commercial wash-and-wear cotton fabrics.

The new finish is applied by dipping the cotton fabri into a water solution of APO and removing the excess b passing the fabric between pressure rollers. The clot is dried at temperatures between 175° F. and 195° F for 4 or more minutes depending on its weight, and the cured at about 285° F. for 4 minutes. ☆

WHY DO CHOCOLATE-COATED CANDIES DRY OUT?

■ Important information on ways of keeping chocolate-coated candies moist has come from cooperative research by USDA and the National Confectioners' Association. This study is being made to improve the utilization of agricultural products, especially sugar and vegetable oils.

The kind of fat in the chocolate coating seems to be the key to the difficulty of candy drying out. In tests at the ARS Southern utilization division, New Orleans, the chocolate's moisture resistance was increased by lowering the liquid-oil content. Increasing the thickness of the film, however, had practically no effect on moisture retention.

Experiments showed that cocoa fat was a fairly good moisture barrier. A film of cocoa fat one-sixteenth inch thick and 1 inch square allowed passage of only a trace of moisture (0.0001 ounce in 24 hours) even when there was a big difference in the relative humidity on each side.

Unsweetened or cooking chocolate allowed only one-fourth as much moisture to pass through as cocoa fat provided the relative humidity stayed below 75 percent. Above 75-percen humidity, protein and other nonfa components of unsweetened chocolate apparently soaked up the moisture which then passed through severa times faster than through cocoa fat.

Milk chocolate behaved much like unsweetened chocolate. When relative humidity was increased to 75 percent or more, however, moisture passed through milk chocolate even faster than unsweetened chocolate. ☆

New cattle grub systemic

Successful testing of a new systemic insecticide encourages USDA researchers to hope for important advances against the cattle grub.

The new insecticide, DOWCO–109, is an organophosphorus compound chemically named O-(4-tert-butyl-2-chlorophenyl) O-methyl methylphoramidothicate. It is effective when given orally as well as when sprayed on the animal, USDA entomologists find. Other chemicals previously tested have been effective for only one method (AGR. RES., December 1956, p. 3; and March 1958, p. 12).

Still experimental, the chemical is not yet available to cattlemen.

Hereford yearlings used in the tests were either sprayed with DOW-CO–109 in the fall or given it by mouth in a pill or capsule. When examined the following spring, the animals were practically free of grubs; controls were infested normally.

Pills or capsules gave as much as 94 to 100 percent protection, and the spray 99 to 100 percent.

Cattle grubs cost millions of dollars a year in meat, milk, and leather. The grubs, as mature heel flies, lay eggs on heel and belly hairs of cattle in the spring. Small maggots hatch and bore into the skin. They travel through the animal's body, emerging through the skin in the back.

Grasshopper forecast

Grasshoppers are likely to be more widespread in the West and Midwest next summer but, on the whole, may be less destructive than in 1958.

A USDA-State survey of adult grasshoppers last fall showed that nearly 23 million acres of rangeland then had enough grasshopper potential to damage crops and grass in 1959. That's 20 percent more acres than were threatened in the fall of 1957. But ARS pest-control officials explain that effective chemical treatment of 5 million infested acres last summer saved local crops and is now paying off in fewer grasshoppers.

Largest range areas with threatening populations are in Colorado, Montana, and California. Wyoming, Utah, Oklahoma, and Texas also had substantial infested acreage. Surveys last fall indicated total acreage infested was highest in Colorado (5,687,000), California (4,523,000), Texas (3,460,000), Oklahoma (2,693,000), and Montana (2,425,000).

In addition to their survey observations, grasshopper-control specialists often get and thoroughly investigate leads on grasshopper infestations from land and forest-management agencies and cattlemen.

Surveyors checked last fall at sample stops in areas that usually harbor these pests, and reported centers of grasshopper buildup. Egg pods were counted to detect any change in the picture, and in most of the States, confirmed the surveyors' previous adult counts. To arrive at an estimate of egg pods in an area, surveyors scrape away debris from the surface of the ground and dig up a square foot of soil. This is screened to sift out the egg pods.

Average annual loss to crops and range in States west of the Mississippi is estimated at $90 million.

Wheat holds quality well

Wheat stored for periods up to 33 years in USDA-State tests made fair to good bread, with thiamine and protein content comparable to that of freshly harvested wheat.

How long and how well wheat will keep is of particular interest when surpluses are great, as at present.

ARS baking technologist C. C. Fifield, and agronomist D. W. Robertson, of the Colorado Agricultural Experiment Station, found that quality of bread recently made from most of the stored wheat samples was the same as for bread made in earlier tests. In a few cases, loaves from old wheat did not rise as much. Texture of crumb and grain scores generally showed a decline in quality compared with earlier years.

Storage had no consistent effect on protein content except that one-third of the samples showed a slight apparent loss, possibly due to sampling error. Thiamine values, too, were the same for the stored as for the freshly-harvested wheat.

Wheat's ability to germinate decreased progressively with age but

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the rate of decrease was not the same for all samples. Kanred variety lost viability somewhat faster than Marquis. Practically all wheat was nonviable after 30 years but, nevertheless, continued to make good bread.

There was a definite and fairly regular increase in fat acidity during storage, indicating a certain amount of progressive deterioration. This, however, was not as apparent in the baking tests as might be expected.

The findings were based on analysis for nitrogen and thiamine content and on baking tests of wheats and flour made from them. Samples of wheat were stored beginning with the 1921 crop, and tests were made periodically over the past 20 years. The researchers plan to make one more series of tests on the stored wheat, possibly in the early 1960's.

Good mountain meadows

Improved management of mountain meadows can mean big gains in beef cattle production efficiency, judging from results of several years of State-USDA research in Colorado (AGR. RES., March 1955, p. 5).

Studies were mainly concerned with forage-crop harvest time, use of irri-

gation water, and fertilization. Researchers compared skillful use of these combined practices with their ordinary use. Skillful use (1) produced market-weight beef animals faster, (2) cut forage intake per pound of beef produced, (3) took less water to produce a pound of forage, (4) increased yields of harvested forage per acre, and (5) increased crude protein content of the forage.

Cattle under good test practices produced a pound of beef on about 13 pounds of forage, compared with 20 pounds under normal conditions.

Differences between good and poor harvest management were reflected in forage quality. Yields from two test cuttings (one early) were generally equal in tonnage to the entire yield of a late cutting. But early-cut plus second-cut forage averaged more than 12 percent crude protein—50 percent more than the late cut. In both cases, about 60 percent was grazed, the rest harvested and fed as hay.

Good water management plus early harvest produced a ton of forage with only 9.5 inches of water per acre. Under usual conditions of water management and late harvest, up to 136 inches per acre are required.

About 135 gallons of water were needed under good water management to produce a pound of hay, and 1,625 gallons for a pound of beef. This compares to 2,000 gallons normally used for a pound of hay, 26,000 gallons for a pound of beef.

The combination of early harvest, nitrogen application, and good irrigation increased hay yield, crude protein, and crude protein per acre. Adding nitrogen produced 12,000 pounds of grass, and 7,500 pounds of grass-legume mixture per acre during a 90-day growing season.

Studies were made on two ranches by ARS soil scientist F. M. Willhite, in cooperation with Colorado Agricultural Experiment Station, at Grand Junction. Rancher research corporations and individuals aided.

Report from the Nautilus

The crew of the first atomic-powered submarine, the Nautilus, made good use of three USDA-developed and commercially prepared prod-

ucts—orange-juice powder and full-flavored, superconcentrated apple and grape juices. The orange powder was developed at the ARS Western utilization division, Albany, Calif., and the juice concentrate at the Eastern utilization division, Philadelphia, Pa.

Last fall, as Nautilus sailed under the ice floes nearing the North Pole, the crew sat down to a satisfying test meal, starting with orange-juice powder reconstituted and chilled. This drink was judged "better than frozen concentrated orange juice."

On a subsequent NATO exercise cruise, the ARS apple and grape-juice products were "very heavily consumed by the crew at all hours." The crew judged the apple juice "outstanding," and the grape juice "very good."

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